Consumers' Association of Canada
Association des consommateurs du Canada

National Office • Siège social
Box 9300
Ottawa, Ontario K1G 3T9
Telephone (613) 733-9450

Publishers of Canadian Consumer and Le consommateur canadien



July 11, 1985

Mr. J. O. Cliffe
432 Martin Grove Road
Islinton, Ontario
M9B 4M2

Re: C.G.S.B. Working Group on MMT in Unleaded Gasolines

Dear Mr. Cliffe:

Thank-you for your information and invitation to attend the inaugural meeting of the above Working Group. Unfortunately, at this time, we do not have anyone that can represent our association at the gathering.

Please keep us informed of the progress of your group and we shall make every effort to appoint someone to sit on our behalf on your committee.

Yours sincerely,

Terry Cave, P. Eng.,
Director,
Technical and Information
Services.

cc: Barb Goit
Excutive Vice President
Consumers' Association of Canada

APPENDIX III

MOTOR VEHICLE MANUFACTURERS' ASSOCIATION

American Motors (Canada) Inc.

Chrysler Canada Ltd.

Ford Motor Company of Canada, Limited

General Motors of Canada Limited

International Harvester Canada Limited

Mack Canada Inc.

Paccar of Canada Ltd.

Volvo Canada Ltd.

Western Star Trucks Inc.

APPENDIX IV

# AUTOMOBILE IMPORTERS OF CANADA

## MEMBERS:

BMW Canada Inc.

Honda Canada Inc.

Hyundai Auto Canada Inc.

Jaguar Canada Inc.

Lada Canada, A Division of TGT
(Trans Globe Trade Inc.)

Mercedes-Benz Canada Inc.

Nissan Automobile Company (Canada) Limited

Rolls-Royce Motor Cars Ltd.

Skocar Inc.

Subaru Auto Canada Ltd.

Suzuki Canada Inc.

Toyota Canada Inc.

Volkswagen Canada Inc.

APPENDIX V

ENVIRONMENT PROTECTION AGENCY - UNITED STATES

Notes reproduced from the Federal Register.

SUPPLEMENTARY INFORMATION:

Section 211(f)(1) of the Act makes it unlawful, effective March 31, 1977, for any manufacturer of a fuel or fuel additive to first introduce into commerce or to increase the concentration in use of any fuel or fuel additive for use in light duty motor vehicles manufactured after model year 1974 which is not substantially similar to any fuel or fuel additive utilized in the certification of any model year 1975 or subsequent model year vehicle or engine under section 206 of the Act.

Section 211(f)(4) of the Act provides that the Administrator of the EPA may waive the prohibitions of section 211(f) upon application of any fuel or fuel additive manufacturer if the Administrator determines that the applicant has established that such fuel or fuel additive will not cause or contribute to a failure of any emission control device or system (over the useful life of any vehicle in which such device or system is used) to achieve compliance by the vehicle with the emission standards with respect to which it has been certified under section 206 of the Act.

Ethyl, in their waiver request, have had the almost impossible task of trying to prove categorically that MMT will not cause or contribute to a failure of any emission control device or system. To date their requests for a waiver have been denied by the EPA.

APPENDIX VI
(Page 1 of 4)

CRC 1978 MMT TESTS
Volvo Cars With Three-Way Catalysts
Bag 1 Results - gHC/mile - Clear Fuel

| MILEAGE | CAR ID V701 | V702 | V703 | AVE |
|---|---|---|---|---|
| 0K | 0.574 | 0.991 | 0.909 | 0.825 |
| 0.3K | 0.846 | 0.600 | 0.639 | |
| 0.3K | 0.610 | 0.587 | 0.657 | |
| 0.3K | 0.925 | | | |
| 0.3K ave | 0.794 | 0.594 | 0.648 | 0.678 |
| 5K | 0.658 | 0.774 | 0.730 | |
| 5K | 0.772 | 0.748 | 0.823 | |
| 5K | | | | |
| 5K ave | 0.715 | 0.761 | 0.777 | 0.751 |
| 10K | 0.559 | 0.620 | 0.833 | |
| 10K | 0.589 | 0.733 | 0.809 | |
| 10K ave | 0.574 | 0.677 | 0.821 | 0.691 |
| 15K | 0.613 | 0.644 | 0.831 | |
| 15K | 0.586 | 0.673 | 0.716 | |
| 15K | 0.564 | | | |
| 15K ave | 0.588 | 0.659 | 0.774 | 0.673 |
| 15.1K | 0.576 | 0.707 | 0.815 | |
| 15.1K | 0.684 | 0.695 | 0.818 | |
| 15.1K ave | 0.630 | 0.701 | 0.817 | 0.716 |
| 22.5K | 0.643 | 0.593 | 0.795 | |
| 22.5K | 0.618 | 0.629 | 0.689 | |
| 22.5K ave | 0.631 | 0.611 | 0.742 | 0.661 |
| 30K | 0.645 | 0.576 | 0.668 | |
| 30K | 0.635 | 0.603 | 0.648 | |
| 30K ave | 0.640 | 0.590 | 0.658 | 0.629 |
| 30.1K | 0.716 | 0.696 | 0.763 | |
| 30.1K | 0.769 | 0.564 | 0.909 | |
| 30.1K ave | 0.743 | 0.630 | 0.836 | 0.736 |
| 37.5K | 0.825 | 0.492 | 0.762 | |
| 37.5K | 0.845 | 0.572 | 0.655 | |
| 37.5K ave | 0.835 | 0.532 | 0.709 | 0.692 |
| 45K | 0.841 | 0.583 | 0.520 | |
| 45K | 0.852 | 0.491 | 0.560 | |
| 45K ave | 0.847 | 0.537 | 0.540 | 0.641 |
| 45.1K | 0.641 | 0.578 | 0.637 | |
| 45.1K | 0.760 | 0.530 | 0.560 | |
| 45.1K ave | 0.701 | 0.554 | 0.599 | 0.618 |
| 50K | 0.847 | 0.614 | 0.653 | |
| 50K | 0.920 | 0.652 | 0.965 | |
| 50K | | | 0.833 | |
| 50K ave | 0.884 | 0.633 | 0.817 | 0.778 |
| 50K-5K | 0.169 | -0.128 | 0.041 | 0.027 |
| 50K-0.3K | 0.090 | 0.040 | 0.169 | 0.099 |
| AVE. 0.3K - 50K | 0.715 | 0.623 | 0.728 | 0.689 |

CRC 1978 MMT TESTS
Volvo Cars With Three-Way Catalysts
Bag 1 Results - gHC/mile - 0.0625gMn/g Fuel

| MILEAGE | CAR ID V722 | V723 | V724 | AVE | MMT Effect Mn-Cl |
|---|---|---|---|---|---|
| 0K | 0.598 | 0.649 | | 0.624 | -0.201 |
| 0.3K | 0.641 | 0.538 | 0.785 | | |
| 0.3K | 0.556 | 0.656 | 0.491 | | |
| 0.3K | | | | | |
| 0.3K ave | 0.599 | 0.597 | 0.638 | 0.611 | -0.067 |
| 5K | 0.612 | 0.541 | 0.945 | | |
| 5K | 0.767 | 0.521 | 0.618 | | |
| 5K | | | 0.565 | | |
| 5K ave | 0.690 | 0.531 | 0.709 | 0.643 | -0.108 |
| 10K | 0.820 | 0.691 | 0.750 | | |
| 10K | 0.745 | 0.665 | 0.746 | | |
| 10K ave | 0.783 | 0.678 | 0.748 | 0.736 | 0.046 |
| 15K | 0.782 | 0.605 | 0.665 | | |
| 15K | 0.779 | 0.642 | 0.744 | | |
| 15K | | | | | |
| 15K ave | 0.781 | 0.624 | 0.705 | 0.703 | 0.030 |
| 15.1K | 0.568 | 0.635 | 0.717 | | |
| 15.1K | 0.567 | 0.608 | 0.729 | | |
| 15.1K ave | 0.568 | 0.622 | 0.723 | 0.637 | -0.079 |
| 22.5K | 0.605 | 0.782 | 0.667 | | |
| 22.5K | 0.674 | 0.674 | 0.617 | | |
| 22.5K ave | 0.640 | 0.728 | 0.642 | 0.670 | 0.009 |
| 30K | 0.713 | 0.834 | 0.715 | | |
| 30K | 0.769 | 0.748 | 0.680 | | |
| 30K ave | 0.741 | 0.791 | 0.698 | 0.743 | 0.114 |
| 30.1K | 0.812 | 0.721 | 0.660 | | |
| 30.1K | 0.707 | 0.661 | 0.699 | | |
| 30.1K ave | 0.760 | 0.691 | 0.680 | 0.710 | -0.026 |
| 37.5K | 0.774 | 0.621 | 0.653 | | |
| 37.5K | 0.859 | 0.657 | 0.740 | | |
| 37.5K ave | 0.817 | 0.639 | 0.697 | 0.717 | 0.026 |
| 45K | 0.571 | 0.594 | 0.546 | | |
| 45K | 0.562 | 0.721 | 0.746 | | |
| 45K ave | 0.650 | 0.651 | 0.663 | 0.655 | 0.014 |
| 45.1K | 0.609 | 0.623 | 0.554 | | |
| 45.1K | 0.624 | 0.661 | 0.675 | | |
| 45.1K ave | 0.617 | 0.642 | 0.615 | 0.624 | 0.007 |
| 50K | 0.984 | 0.654 | 0.591 | | |
| 50K | 0.631 | 0.723 | 0.677 | | |
| 50K | 0.771 | | | | |
| 50K ave | 0.795 | 0.689 | 0.634 | 0.706 | -0.072 |
| 50K-5K | 0.106 | 0.158 | -0.075 | 0.063 | 0.036 |
| 50K-0.3K | 0.197 | 0.092 | -0.004 | 0.095 | -0.005 |
| AVE. 0.3K - 50K | 0.703 | 0.657 | 0.679 | 0.680 | -0.009 |

CRC 1978 MMT TESTS
Volvo Cars With Three-Way Catalysts
Bag 2 Results - gHC/mile - Clear Fuel

| MILEAGE | CAR ID V701 | V702 | V703 | AVE |
|---|---|---|---|---|
| 0K | 0.025 | 0.031 | 0.009 | 0.022 |
| 0.3K | 0.021 | 0.030 | 0.011 | |
| 0.3K | 0.018 | 0.025 | 0.016 | |
| 0.3K | 0.011 | | | |
| 0.3K ave | 0.017 | 0.028 | 0.014 | 0.019 |
| 5K | 0.010 | 0.032 | 0.010 | |
| 5K | 0.022 | 0.033 | 0.013 | |
| 5K | | | | |
| 5K ave | 0.016 | 0.033 | 0.012 | 0.020 |
| 10K | 0.012 | 0.020 | 0.006 | |
| 10K | 0.010 | 0.022 | 0.012 | |
| 10K ave | 0.011 | 0.021 | 0.009 | 0.014 |
| 15K | 0.028 | 0.033 | 0.022 | |
| 15K | 0.035 | 0.025 | 0.022 | |
| 15K | 0.024 | | | |
| 15K ave | 0.029 | 0.029 | 0.022 | 0.027 |
| 15.1K | 0.025 | 0.020 | 0.025 | |
| 15.1K | 0.021 | 0.011 | 0.034 | |
| 15.1K ave | 0.023 | 0.016 | 0.030 | 0.023 |
| 22.5K | 0.033 | 0.025 | 0.024 | |
| 22.5K | 0.032 | 0.029 | 0.025 | |
| 22.5K ave | 0.033 | 0.027 | 0.025 | 0.028 |
| 30K | 0.032 | 0.015 | 0.036 | |
| 30K | 0.036 | 0.019 | 0.036 | |
| 30K ave | 0.034 | 0.017 | 0.036 | 0.029 |
| 30.1K | 0.035 | 0.024 | 0.030 | |
| 30.1K | 0.034 | 0.021 | 0.026 | |
| 30.1K ave | 0.035 | 0.023 | 0.028 | 0.028 |
| 37.5K | 0.047 | 0.028 | 0.029 | |
| 37.5K | 0.019 | 0.026 | 0.023 | |
| 37.5K ave | 0.033 | 0.027 | 0.026 | 0.029 |
| 45K | 0.044 | 0.025 | 0.031 | |
| 45K | 0.044 | 0.022 | 0.031 | |
| 45K ave | 0.044 | 0.024 | 0.031 | 0.033 |
| 45.1K | 0.041 | 0.031 | 0.031 | |
| 45.1K | 0.036 | 0.043 | 0.028 | |
| 45.1K ave | 0.039 | 0.037 | 0.030 | 0.035 |
| 50K | 0.048 | 0.050 | 0.042 | |
| 50K | 0.057 | 0.054 | 0.044 | |
| 50K | | | 0.044 | |
| 50K ave | 0.053 | 0.052 | 0.043 | 0.049 |
| 50K-5K | 0.037 | 0.020 | 0.032 | 0.029 |
| 50K-0.3K | 0.036 | 0.025 | 0.030 | 0.030 |
| AVE. 0.3K - 50K | 0.030 | 0.028 | 0.025 | 0.028 |

CRC 1978 MMT TESTS
Volvo Cars With Three-Way Catalysts
Bag 2 Results - gHC/mile - 0.0625gMn/g Fuel

| MILEAGE | CAR ID V722 | V723 | V724 | AVE | MMT Effect Mn-Cl |
|---|---|---|---|---|---|
| 0K | 0.039 | 0.026 | | 0.033 | 0.011 |
| 0.3K | 0.025 | 0.022 | 0.016 | | |
| 0.3K | 0.028 | 0.024 | 0.028 | | |
| 0.3K | | | | | |
| 0.3K ave | 0.027 | 0.023 | 0.022 | 0.024 | 0.005 |
| 5K | 0.038 | 0.021 | 0.077 | | |
| 5K | 0.035 | 0.017 | 0.071 | | |
| 5K | | | 0.087 | | |
| 5K ave | 0.037 | 0.019 | 0.078 | 0.045 | 0.025 |
| 10K | 0.049 | 0.028 | 0.177 | | |
| 10K | 0.048 | 0.028 | 0.166 | | |
| 10K ave | 0.049 | 0.028 | 0.172 | 0.083 | 0.069 |
| 15K | 0.105 | 0.031 | 0.155 | | |
| 15K | 0.085 | 0.032 | 0.265 | | |
| 15K | | | | | |
| 15K ave | 0.095 | 0.032 | 0.210 | 0.112 | 0.086 |
| 15.1K | 0.040 | 0.022 | 0.057 | | |
| 15.1K | 0.042 | 0.025 | 0.069 | | |
| 15.1K ave | 0.041 | 0.024 | 0.063 | 0.043 | 0.020 |
| 22.5K | 0.089 | 0.101 | 0.084 | | |
| 22.5K | 0.080 | 0.078 | 0.075 | | |
| 22.5K ave | 0.085 | 0.090 | 0.080 | 0.085 | 0.057 |
| 30K | 0.099 | 0.066 | 0.131 | | |
| 30K | 0.097 | 0.058 | 0.101 | | |
| 30K ave | 0.098 | 0.062 | 0.116 | 0.092 | 0.063 |
| 30.1K | 0.063 | 0.035 | 0.054 | | |
| 30.1K | 0.081 | 0.034 | 0.056 | | |
| 30.1K ave | 0.072 | 0.035 | 0.055 | 0.054 | 0.026 |
| 37.5K | 0.165 | 0.049 | 0.047 | | |
| 37.5K | 0.112 | 0.043 | 0.061 | | |
| 37.5K ave | 0.139 | 0.046 | 0.054 | 0.080 | 0.051 |
| 45K | 0.072 | 0.067 | 0.039 | | |
| 45K | 0.069 | 0.077 | 0.060 | | |
| 45K ave | 0.071 | 0.072 | 0.050 | 0.064 | 0.031 |
| 45.1K | 0.056 | 0.044 | 0.053 | | |
| 45.1K | 0.044 | 0.043 | 0.051 | | |
| 45.1K ave | 0.050 | 0.044 | 0.052 | 0.049 | 0.014 |
| 50K | 0.075 | 0.072 | 0.055 | | |
| 50K | 0.062 | 0.070 | 0.059 | | |
| 50K | 0.056 | | | | |
| 50K ave | 0.064 | 0.071 | 0.057 | 0.064 | 0.015 |
| 50K-5K | 0.028 | 0.052 | -0.021 | 0.020 | -0.010 |
| 50K-0.3K | 0.038 | 0.048 | 0.035 | 0.040 | 0.010 |
| AVE. 0.3K - 50K | 0.069 | 0.045 | 0.084 | 0.066 | 0.038 |

CRC 1978 MMT TESTS
Volvo Cars With Three-Way Catalysts
Bag 3 Results - gHC/mile - Clear Fuel

| MILEAGE | CAR ID V701 | V702 | V703 | AVE |
|---|---|---|---|---|
| 0K | 0.148 | 0.153 | 0.089 | 0.130 |
| 0.3K | 0.129 | 0.088 | 0.080 | |
| 0.3K | 0.139 | 0.090 | 0.071 | |
| 0.3K | 0.067 | | | |
| 0.3K ave | 0.112 | 0.089 | 0.076 | 0.092 |
| 5K | 0.090 | 0.167 | 0.083 | |
| 5K | 0.100 | 0.150 | 0.065 | |
| 5K | | | | |
| 5K ave | 0.095 | 0.159 | 0.074 | 0.109 |
| 10K | 0.093 | 0.079 | 0.067 | |
| 10K | 0.076 | 0.082 | 0.080 | |
| 10K ave | 0.085 | 0.081 | 0.074 | 0.080 |
| 15K | 0.090 | 0.086 | 0.084 | |
| 15K | 0.095 | 0.086 | 0.153 | |
| 15K | 0.098 | | | |
| 15K ave | 0.094 | 0.086 | 0.119 | 0.100 |
| 15.1K | 0.088 | 0.061 | 0.086 | |
| 15.1K | 0.068 | 0.064 | 0.075 | |
| 15.1K ave | 0.078 | 0.063 | 0.081 | 0.074 |
| 22.5K | 0.121 | 0.069 | 0.106 | |
| 22.5K | 0.120 | 0.080 | 0.069 | |
| 22.5K ave | 0.121 | 0.075 | 0.088 | 0.094 |
| 30K | 0.125 | 0.078 | 0.105 | |
| 30K | 0.118 | 0.083 | 0.100 | |
| 30\30K ave | 0.122 | 0.081 | 0.103 | 0.102 |
| 30.1K | 0.132 | 0.077 | 0.102 | |
| 30.1K | 0.123 | 0.083 | 0.100 | |
| 30.1K ave | 0.128 | 0.080 | 0.101 | 0.103 |
| 37.5K | 0.141 | 0.086 | 0.089 | |
| 37.5K | 0.161 | 0.086 | 0.130 | |
| 37.5K ave | 0.151 | 0.086 | 0.110 | 0.116 |
| 45K | 0.165 | 0.093 | 0.125 | |
| 45K | 0.075 | 0.082 | 0.144 | |
| 45K ave | 0.120 | 0.088 | 0.135 | 0.114 |
| 45.1K | 0.115 | 0.099 | 0.102 | |
| 45.1K | 0.123 | 0.076 | 0.108 | |
| 45.1K ave | 0.119 | 0.088 | 0.105 | 0.104 |
| 50K | 0.161 | 0.112 | 0.136 | |
| 50K | 0.180 | 0.120 | 0.144 | |
| 50K | | | 0.138 | |
| 50K ave | 0.171 | 0.116 | 0.139 | 0.142 |
| 50K-5K | 0.076 | -0.043 | 0.065 | 0.033 |
| 50K-0.3K | 0.059 | 0.027 | 0.064 | 0.050 |
| AVE. 0.3K - 50K | 0.116 | 0.091 | 0.100 | 0.102 |

CRC 1978 MMT TESTS
Volvo Cars With Three-Way Catalysts
Bag 3 Results - gHC/mile - 0.0625gMn/g Fuel

| MILEAGE | CAR ID V722 | V723 | V724 | AVE | MMT Effect Mn-Cl |
|---|---|---|---|---|---|
| 0K | 0.081 | 0.187 | | 0.134 | 0.00 |
| 0.3K | 0.085 | 0.122 | 0.107 | | |
| 0.3K | 0.087 | 0.202 | 0.131 | | |
| 0.3K | | | | | |
| 0.3K ave | 0.086 | 0.162 | 0.119 | 0.122 | 0.03 |
| 5K | 0.109 | 0.216 | 0.198 | | |
| 5K | 0.124 | 0.135 | 0.140 | | |
| 5K | | | 0.158 | | |
| 5K ave | 0.117 | 0.176 | 0.165 | 0.152 | 0.04 |
| 10K | 0.125 | 0.187 | 0.255 | | |
| 10K | 0.163 | 0.196 | 0.281 | | |
| 10K ave | 0.135 | 0.186 | 0.234 | 0.185 | 0.10 |
| 15K | 0.254 | 0.149 | 0.256 | | |
| 15K | 0.229 | 0.150 | 0.254 | | |
| 15K | | | | | |
| 15K ave | 0.242 | 0.150 | 0.255 | 0.215 | 0.11 |
| 15.1K | 0.110 | 0.099 | 0.208 | | |
| 15.1K | 0.114 | 0.099 | 0.820 | | |
| 15.1K ave | 0.112 | 0.099 | 0.514 | 0.242 | 0.16 |
| 22.5K | 0.155 | 0.192 | 0.173 | | |
| 22.5K | 0.147 | 0.167 | 0.168 | | |
| 22.5K ave | 0.151 | 0.180 | 0.171 | 0.167 | 0.07 |
| 30K | 0.180 | 0.213 | 0.254 | | |
| 30K | 0.167 | 0.237 | 0.224 | | |
| 30K ave | 0.174 | 0.225 | 0.239 | 0.213 | 0.11 |
| 30.1K | 0.126 | 0.130 | 0.128 | | |
| 30.1K | 0.125 | 0.128 | 0.145 | | |
| 30.1K ave | 0.126 | 0.129 | 0.137 | 0.130 | 0.02 |
| 37.5K | 0.174 | 0.137 | 0.160 | | |
| 37.5K | 0.268 | 0.158 | 0.173 | | |
| 37.5K ave | 0.221 | 0.148 | 0.167 | 0.178 | 0.06 |
| 45K | 0.168 | 0.196 | 0.175 | | |
| 45K | 0.164 | 0.180 | 0.148 | | |
| 45K ave | 0.166 | 0.188 | 0.162 | 0.172 | 0.05 |
| 45.1K | 0.133 | 0.137 | 0.186 | | |
| 45.1K | 0.136 | 0.143 | 0.129 | | |
| 45.1K ave | 0.135 | 0.140 | 0.158 | 0.144 | 0.04 |
| 50K | 0.151 | 0.198 | 0.140 | | |
| 50K | 0.156 | 0.196 | 0.146 | | |
| 50K | 0.151 | | | | |
| 50K ave | 0.153 | 0.197 | 0.143 | 0.164 | 0.02 |
| 50K-5K | 0.036 | 0.022 | -0.022 | 0.012 | -0.02 |
| 50K-0.3K | 0.067 | 0.035 | 0.024 | 0.042 | -0.00 |
| AVE. 0.3K - 50K | 0.151 | 0.165 | 0.205 | 0.174 | 0.07 |

# APPENDIX 11

COMMENTS ON SAE PAPER 890582

# "CHARACTERIZATION OF AUTOMOTIVE CATALYST EXPOSED TO THE FUEL ADDITIVE MMT"

BY

ETHYL CORPORATION

1 MARCH, 1989

Ethyl Corporation appreciates the opportunity to comment on SAE Paper 890582 titled "Characterization of Automotive Catalysts Exposed to the Fuel Additive MMT."

Using very few catalytic converters of unknown history, with no supporting tailpipe emission data and with a laboratory test for which no field correlation is shown, the authors conclude that "it appears that the fuel additive MMT had a deleterious effect on the efficiency of the catalysts tested." They report, but otherwise ignore, the lead on the converter and type of service.

Ethyl® MMT Antiknock Compound has been used in Canadian unleaded gasoline since 1977 at levels up to the Canadian General Standards Board (CGSB) maximum of 18 mg Mn/liter. To our knowledge, the nine catalytic converters referred to in this paper represent the first reported problems in Canada. Furthermore, in 1986 a Working Group within CGSB, on which Ford was represented, did not report any complaints due to MMT. In answer to system durability questions, the Working Group concluded that:

> "The use of MMT at current CGSB levels does not significantly compromise emission-control system operation or component durability."

We refer now to 1979 and 1984 articles written by Ford and

published in American Chemical Society journals. (1,2) Both articles address the negative effects of lead on precious metal catalysts. In the 1979 article the authors state "these noble-metal TWC's are susceptible to poisoning by fuels." Using a pulse-flame reactor and fuel containing only 7 mg Pb/gal., the test converter efficiency dropped by 10% at near stoichiometric conditions. At a rich condition converter efficiency dropped by 50%. Since 1979, both catalyst chemistry and lead contamination have changed. Nevertheless, we believe that the potential effect of lead must be addressed.

With the range of lead levels (0.02-0.74% wt.) exhibited in SAE Paper 890582, we believe it is appropriate to assume that some degree of misfueling occurred. Ford addressed this in 1984. (2) "...if misfueling does occur the restoration of catalyst activity by simply reverting to unleaded fuel will not be very effective..." Based on catalyst industry comments, the lower lead levels in gasoline and/or the reduced incidence of misfueling which now exist may have lead to the use of higher palladium content catalysts. If so, the finding of the 1984 ACS article becomes even more important. "The deactivation of Pd (palladium) catalysts by lead (Pb) is more severe than for Pt (platinum)."

We again turn to previous SAE papers by Ford for an analysis of MMT's effect on catalytic converters. Specifically, Gandhi, et al state that "catalytic converter efficiencies for HC were found 2-3% higher with MMT fuels than with clear fuels after 50,000 miles". Lead levels of 0.24 to 0.45% wt. Pb were considered catalyst contaminants. In fact, 0.45% wt. Pb on the converter inlet without MMT, significantly reduced convertor efficiency (52% con. eff. for HC). (3)

A second vehicle operating on gasoline containing 0.125 g Mn/gal contained 0.24% wt. Pb on the convertor but completed 50,000 miles with 80% conversion efficiency for HC. In the conclusion section of SAE Paper 821193 Ford states:

> "The vehicle data presented using 0.125g Mn/gal indicates retention levels of 1-2% Mn on the catalyst while reducing the levels of P, Zn, and Pb contaminants. Use of 0.125g Mn/gal for 50,000 mi at 12 mpg (1975 estimate) would result in approximately 520 g Mn input. The retention of 2% wt. Mn on a 1100 g monolithic catalyst represents 22 g or only 4% of the input Mn retained by catalyst compared to approximately 35% Pb retention in absence of MMT. This low retention of Mn is indicative of inert products which are only physically deposited and not chemically bound to the catalyst surface."

This information can be compared to manganese levels of 4.2-6.14% wt. for the two convertors analyzed in SAE Paper 890582. If we assume that the average level of MMT in Canadian gasoline was 0.03 g Mn/gal and the average fuel consumption of the two cars was 18 mpg, then a gross anomaly exists.

Recent Ethyl testing of a monolithic three-way catalyst showed manganese retention of 2.0% wt. Mn on the catalyst inlet. This catalytic converter had operated for 50,000 miles on gasoline containing 0.0625 g Mn/gallon. The lead level on the catalyst was only 0.025 wt.%.

We feel that considerable evidence suggests that the converters in the small sample examined by Ford had unusual histories, and question the assumption that "the vehicles were properly adjusted and fueled with gasoline that met the Canadian standard of 1/16 g/gal." If all cars were fueled properly, one must question why lead levels on the catalyst inlet ranged up to 0.75% wt. Second, proper maintenance is unfortunately not that common. Third, manganese retention substantially exceeds expectations.

In the summer of 1987, Ethyl Corporation undertook a program to determine if MMT was affecting Canadian cars equipped with current technology emission control systems. Using tailpipe exhaust emissions as our guide, we evaluated 15 1987 Canadian cars of which 5 were Fords. A similar group of U.S. cars was evaluated for comparison purposes. As an entire group and as a Ford subset, the emission data and operating experience do not suggest converter problems.

In 1988 we began a comprehensive 48-car test program to evaluate the performance of current technology engines and emission control systems. Half of the fleet are being operated on untreated Howell EEE gasoline and half on Howell EEE gasoline plus MMT. The test program is approximately at the halfway point. No incidence of catalyst plugging, emission system deactivation or excessive change in tailpipe emissions has been observed.

One very important feature being observed in Ethyl's current 48-car program relates to NOx emissions. In almost every case, the vehicle(s) operating on gasoline containing MMT exhibit a statistically significant decrease in the increase in NOx emissions over mileage when compared to control car emissions. Under very simple stoichiometric situations this could allow engine operation while maintaining excellent leaner NOx conversion efficiency. A decrease in NOx emissions from vehicles could result in reduced ozone formation.

We are continuing to generate extensive information from our on-the-road test program. In addition to emission and operability data, we plan to obtain information on the composition of converters after extensive use with fuels containing manganese from Ethyl MMT Antiknock Compound.

References:

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